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PHOTO-ELECTRIC PHOTOMETRY OF THE 1918 ECLIPSE.

BY JAKOB KUNZ AND JOEL STEBBINS.

(*Read April 25, 1919.*)

The expedition from the University of Illinois had for the sole item on its program the measurement of the total light of the corona by means of photo-electric cells. The arrangement consists of a light-sensitive cell connected in series with a galvanometer and a battery giving about 150 volts. When exposed to a light about equal to that of the crescent moon, a measurable current is produced, and it was anticipated that the corona would be bright enough to be measured with accuracy. The advantage of this electrical photometer is that no matter what the distribution of light is in the source, whether it be a point or an irregular surface, the effect is integrated and is combined into a single galvanometer deflection.

The color-sensitivity of the potassium cell is nearly like that of the ordinary unstained photographic plate, the maximum effect being at wave-length 4500 Å. In a general way, the photo-electric measures are between photographic and visual, but nearer the former.

Slide 1 shows one of these cells, the diameter of the bulb being about one inch.

Slide 2.—The station at Rock Springs, Wyoming, was selected so as to be near the Yerkes camp, where Mr. Parkhurst was to undertake visual photometric measures of the corona, for it was felt that there would be advantages in having observations by different methods, but with practically the same atmospheric conditions. However, we did not want a local cloud to spoil all of the photometry, so we located about fifteen miles east of the Green River people, and about two miles south of the town of Rock Springs.

Slide 3.—General view of the station.

Slide 4.—It was proposed to take measures in duplicate with two cells, each mounted in a box at the lower end of a simple tube. The

twin tubes were fastened on an equatorial mounting, but a driving clock was unnecessary. (Note: the simple tubes were made of four-inch down-spouts.)

Slide 5.—The electrical connection from each cell was carried in conduit to the galvanometer and battery inside the hut. Each cell box could be detached from the mounting outside, and brought in to the photometer bench. Here it was arranged that the cell could be exposed to a standard amyl acetate candle at varying distances, and also to standard low-voltage electric lamps. The same apparatus was also used to compare the lamps with the full moon, and thus to get an indirect measure of the corona in terms of moon light.

Slide 6.—Two assistants operated the apparatus outside, while the observers read the galvanometers.

Slide 7.—Our expedition had the same unfortunate experience with the weather that other parties had on the days preceding the eclipse. The nights and early mornings were usually clear, but clouds, increasing during the day, were usually worst about the hour of the eclipse, 5 P.M. The picture shows the conditions thirty minutes before totality.

Slide 8.—At six minutes before the critical time the sun was still behind the cloud at the upper left-hand corner of the picture, but at two minutes before time the cloud had moved away, and during totality the corona stood out in a perfectly clear sky.

RESULTS.

We secured four complete measures of the light of the corona, and of the sky background. When proper allowance is made for the absorption of the earth's atmosphere, it is found that the total light of the corona was 1.07 candle meters, just half the light of the full moon. There has been a curious disagreement between observers at previous eclipses, as values have been found ranging from one fortieth to ten times the moon's light, a difference of 400-fold. These were results from photographs, but the more reliable determinations seemed to indicate a value of one tenth full moon, five times smaller than our value. The visual results are in much better agreement, ranging from half up to one full moon, or from the same up to twice our value.

Our comparison of the corona with the sky before and during the eclipse shows that, in terms of a circle of sky of the apparent size of the sun, the corona gave one tenth as much light in full sunshine, but more than 600 times as much during totality. The decrease in the light of the sky due to the moon's shadow was therefore 6,000-fold. As the decrease from sunlight to corona light is fully 100 times 6,000, this means that not more than 1 per cent. of the general sky illumination during an eclipse can come from the corona, the remainder being from sunlight reflected from the earth's surface and atmosphere which is outside the moon's shadow.

The result that the corona gives one tenth of the light from a circle of daylight sky of the same area as the sun, and 8° away, has a direct bearing upon the problem of detecting the corona without an eclipse. Experiments in using photo-electric cells for this purpose have already been begun by Dr. Hale at the Mt. Wilson Observatory.

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